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Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Calorimeter Risk Management Plan

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1.0 INTRODUCTION

The GLAST LAT Calorimeter Continuous Risk Management (CRM) Plan, defines the process and implementation of CRM on the GLAST LAT Calorimeter. The GLAST LAT Calorimeter will utilize CRM as a decision-making tool to enable programmatic and technical success. Decisions will be made on the basis of an orderly risk management effort, including the identification, assessment, mitigation, and disposition of risks throughout the project life cycle. Applying CRM on the Project ensures that communications and documentation are maintained across the entire Project. The initial description of this process has been provided in the NASA Procedures and Guidelines (NPG) 7120.5A, NASA Program and Project Management Processes and Requirements Document. This CRM Plan is intended to complement overall GLAST LAT Calorimeter management of which CRM will be an integral part. To have an effective CRM program, this plan solicits participation from everyone in the Project.

1.1 Purpose

The purpose of this document is to describe how CRM is to be applied on the GLAST LAT Calorimeter. Included in this plan are descriptions of the CRM processes necessary to carry out this effort. This plan is to be used by the Project to make informed decisions, optimize allocation and use of resources, and coordinate design and programmatic trades against mission cost, schedule, and technical performance.

1.2 Scope

This document describes the processes for utilizing CRM across all aspects of the GLAST LAT Calorimeter. The objective of CRM is to manage programmatic and technical risks before they become problems. The intent of this document is to formalize CRM throughout the life cycle of the Project. To the extent possible, the GLAST LAT Calorimeter will utilize lessons learned from other GSFC and NASA Programs in carrying out this CRM Plan.

1.3 Document Organization

This document is organized into seven major sections.

Section 1 is an introduction to the document.

Section 2 provides an overview of the CRM process.

Section 3 describes the Project's personnel functional roles and responsibilities within the CRM process.

Section 4 discusses performing risk identification, analysis, and planning.

Section *5* describes the tracking, control, communication, and documentation necessary for CRM.

Section 6 describes the processes, methods, and tools used to implement CRM on the GLAST LAT Calorimeter.

Appendix A, which contains a list of acronyms used in this document.

Appendix B, which includes the GLAST LAT Calorimeter Risk Information Sheet (B-1) and a description of the GLAST LAT Calorimeter Risk Tracking Log (RTL) (B-2).

1.4 Assumptions, Constraints, and Policies

The GLAST LAT Calorimeter is being implemented under cost and schedule constraints. As a result, resources allocated for CRM will come from established budgets. The GLAST LAT Calorimeter PM will approve all resources required to mitigate risks. The GLAST LAT Calorimeter CRM Plan will be baselined and put under configuration control. All other GLAST LAT Calorimeter team member CRM Plans must be in accordance with this plan.

1.5 Related Documents and Standards

This section lists GLAST LAT Calorimeter CRM Plan related documents. Section *1.5.1* lists the parent document that establishes the criteria and technical basis for this document. The NPG 7120.SA, "NASA Program and Project Management Processes and Requirements", is the controlling requirements/guideline used in the preparation of this plan. Section 1.5.2 lists the applicable documents that are in conformance with the requirements and contents of this document. Section *1.5.3* lists reference documents for informational purposes.

1.5.1 Parent Document

GLAST LAT Calorimeter Specification,

1.5.2 Applicable Documents

NPG 7120.5A	NASA Program and Project Management Processes and Requirements Document, Revision A, Dated April 3, 1998
Continuous Risk Management Guidebook, Carnegie Mellon Institute, Software Engineering Institute, Dated August 1996	
NASA-STD-8719.13A	NASA Software Safety Standard
NASA-SP-6 105	NASA Systems Engineering Handbook, Dated June 1995

1.5.3 Reference Documents

GSFC 422-11-12-04	Earth Observing System (EOS) Aura Project Risk Management Plan, Dated November, 1994
GSFC 410-MIDEX-003	Medium Explorer (MIDEX) Program, Safety, Reliability & Quality Assurance Requirements, Draft Dated January 18, 2001

2.0 OVERVIEW OF THE CRM PROCESS

This section provides an overview of the CRM process. Details of how this process is applied to the GLAST LAT Calorimeter are provided in subsequent sections of this Plan.

2.1 Primary CRM Activities

There are six primary activities of the CRM process:

- Risk Identification
  Continuous efforts by the project to capture, acknowledge, and document risks as they are found.

- Risk Analysis
  A process by which the project evaluates all identified risks to estimate the probability of occurrence, severity of impact, timeframe when mitigation actions are needed, classification into sets of related risks, and priority ranking.

- Risk Planning
  Establishes actions, plans, and approaches for addressing risks and assigns responsibilities and schedules for completion. Metrics for determining the risk status is also defined during this step.

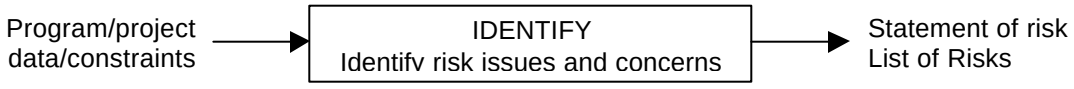
- Risk Tracking
  An activity to capture, compiles, and reports risk attributes and metrics, which determine whether or not risks are being mitigated effectively and risk mitigation plans, are being performed correctly.

- Risk Control
  An activity that utilizes the status and tracking information to make a decision about a risk or risk mitigation effort. A risk may be closed or watched, a mitigation action may be replanted, or a contingency plan may be invoked. Decisions on the appropriate resources needed are also determined during this activity.

- Risk Communication and Documentation:
  An overt action to communicate and document the risk at all steps of the CRM process. This can be in the form of a Response For Action (RFA) list, risk information sheet, risk database, mitigation plan, status report, and/or risk tracking log.

2.2 The CRM Process

The CRM process is illustrated in Figure 2-1. The diagram depicts the inputs and outputs of risk identification, planning, analysis, tracking, and controlling activities and overlays the reporting and communication activities.



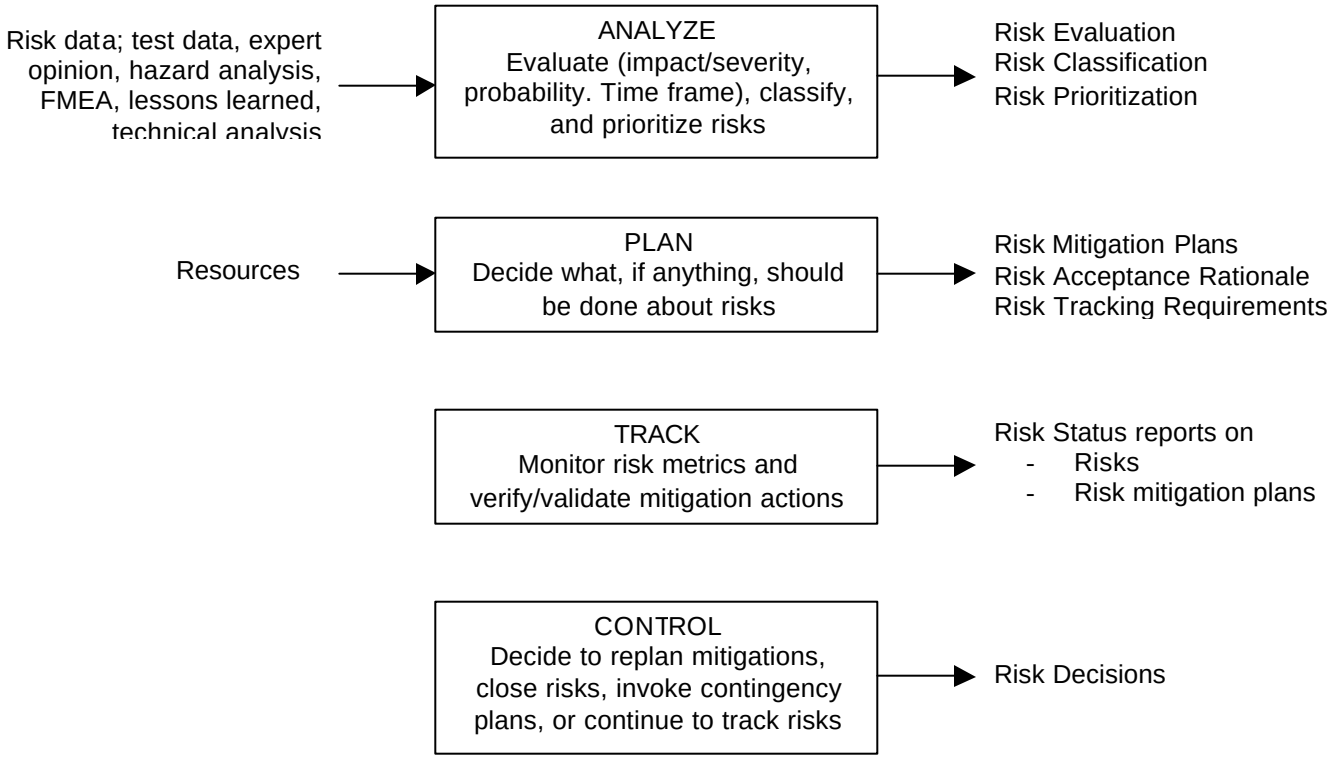


Figure 2-1 Continuous Risk Management Process

3.0 GLAST LAT CALORIMETER ORGANIZATION

This section describes GLAST LAT Calorimeter personnel functional roles and responsibilities within the CRM process. CRM is carried out during the day-to-day activities of Project personnel as well as during key project meetings.

3.1 The GLAST LAT Calorimeter Organization

The GLAST LAT Calorimeter Subsystem manager (SM) leads a development team consisting of NRL, SLAC, and international partners. He also has overall responsibility for CRM on the Project. The GLAST LAT Calorimeter Project Manager (PM) is responsible for implementing and managing the CRM process and reporting status to the GLAST LAT Calorimeter SM.

3.2 Project Communication and Responsibilities

The GLAST LAT Calorimeter SM has overall responsibility for CRM on the Project. The GLAST LAT Calorimeter SM approves funds to be allocated for risk mitigation and for reporting risk status. The GLAST LAT Calorimeter PM has oversight responsibility of CRM implementation on the Project and reports status to the GLAST LAT Calorimeter SM. The SM

will be assisted by Quality Assurance (QA) to assure that the Project complies with GLAST LAT Calorimeter CRM processes and procedures and is responsible for the execution and maintenance of this Plan. Table 3-1 depicts the responsibilities of GLAST LAT Calorimeter personnel within the GLAST LAT Calorimeter.

3.3 GLAST LAT Calorimeter Risk Management Board

The GLAST LAT Calorimeter Risk Management Board (CRMB) is established to support the management of project risks as described in Table 3-1. The CRMB shall meet as requested by the PM to review and assess identified risks. The CRMB is Chaired by the PM and co-chaired by Quality Assurance. Board members shall be comprised from the following personnel or their designated representatives on an as needed basis:

- Subsystems Manager (Ground and Flight)
- Software Manager
- Calorimeter Program Manager
- Quality Assurance

Table 3-1 Risk Management Responsibilities

Who	**Responsibilities**
GLAST LAT Calorimeter PM, subsystems Manager, Functional Managers including :Software and Individuals including GLAST LAT Calorimeter Resources Manager, Scheduler, and Contractors	• Identify new risks. • Assist in risk prioritizing. • Utilize NASA Lessons Learned Information System (LLIS) to identify/mitigate potential risks.
GLAST LAT Calorimeter CRMB, PM,	• Integrate risk information from all individuals within a functional area. • Ensure accuracy of probability /impact/timeframe estimates and the classification. • Estimate probability, impact, and time frame. • Classify risks. • Recommend approach and actions. • Track risks and mitigation plans (acquire, compile, and report. • Utilize NASA Lessons Learned Information System (LLIS) to identify, evaluate and validate risks.
PM and QA	• Maintain risk tracking log and database. • Maintain GLAST LAT Calorimeter Risk Information System.
GLAST LAT Calorimeter CRMB, PM, and QA	• Review recommendations on mitigation approach and action. • Reprioritize all risks to determine Top 20% risks. • Assign or change responsibility for risks and mitigation plans. • Report Top 20% risks to the GLAST LAT Calorimeter Manager. • Implement control decisions for risks. • Build action plans (determine approach, define scope, & actions). • Collect and report general risk measures/metrics.
GLAST LAT Calorimeter SM, PM, and QA	• Authorize expenditures of resources for mitigation. • Integrate risk information from all FMs. • Reprioritize all risks to determine the Top 20% Project risks. • Make control decisions (analyze, decide, execute) for lop 20% Project risks. • Assign or change responsibility for risks and mitigation plans within the Project.

4.0 RISK IDENTIFICATION, ANALYSIS, AND PLANNING

The first three phases of CRM is performing risk identification, analysis, and planning. These steps are necessary in order to record and prioritize Project risks. The following sections describe these phases.

4.1 Risk Identification

The risk identification process identifies risks that are likely to have undesirable consequences on the Project. The identification of Project risks shall be a continuous process throughout the life cycle of the mission. The GLAST LAT Calorimeter will establish a baseline set of risks that shall be updated or reestablished periodically at major Project milestones. The PM/QA shall interview the designated individuals (contractors, development team members, etc.) using a short Taxonomy-Based Questionnaire (TBQ) and brainstorming to identify risks. Project risks will also be identified in programmatic and technical meetings, telecons, reviews, and other communication interchanges. All risks are to be captured and recorded in the GLAST LAT Calorimeter Risk Information Sheet (see Appendix B) to be analyzed and tracked by the Project. Table 4-1 describes the process used for risk identification.

Table 4-1. Risk Identification Process

Step	Action
1	New risks are identified through interviews, using TBQ and brainstorming, and at team meetings and reviews
2	The originator will develop a risk statement and context of the new risk on the GLAST LAT Calorimeter Risk Information Sheet (see Appendix B).
3	A keyword search is performed in the NASA Lessons Learned Information System (LLIS), http://llis.nasa.gov.
4	If the risk is accepted, a risk identification number is assigned, a person is assigned responsibility for closing the risk, and the risk is tracked until closure. If rejected, the Risk Information Sheet will be returned to the originator with an explanation.
5	Risk Information Sheet statements are reviewed bi-weekly by the PM

Risks identified during Project meetings or interviews shall be captured and added to the Risk Information Sheet within seven working days following the meeting and submitted. It is the responsibility of the meeting leader to make sure all relevant information is provided on the Risk Information Sheet.

As new risks are identified through team meetings and interviews a decision shall be made by the PM to accept the risk or delegate responsibility for the risk to the other team members. The GLOATS LAT Calorimeter PM, if necessary, may request an external organization to address the risk, if best suited.

4.1.1 Response for Actions (RFAs)

The Office of Systems Safety and Mission Assurance, Code 300 assigns RFAs to the Project at major reviews. The GLAST LAT Calorimeter Systems Manager shall maintain an RFA log and assigns a tracking number for each action. The GLAST LAT Calorimeter PM assigns each RFA to an individual who is responsible to work the RFA to closure. Contested and closed RFAs shall be considered for entry in the project's CRM program. If the RFA is not closed by the next scheduled Project review, the RFA will be elevated to a risk and entered on to a Risk Information Sheet.

4.2 Risk Analysis

The purpose of risk analysis process is to convert the Risk Information Sheet data into decision-making information. The GLAST LAT Calorimeter will use this process to examine the risks in detail to determine the extent of the risks, how they relate to each other, and which ones are the most important.

The risk analysis process begins when a technical or programmatic risk is identified on a Risk Information Sheet. Risk analysis has three basic activities: evaluating the attributes of the risks (impact, probability, and timeframe), classifying the risks, and prioritizing or ranking the risks. The risk analysis process is described in Table 4-2.

Table 4-2 GLAST LAT Calorimeter Risk Analysis Process

Step	Action
1	CRMB will evaluate the attributes (impact, probability, and timeframe) of the new risk. Additional analysis may be requested.
2	The risk attributes are entered into the GLAST LAT Calorimeter Information Sheet.
3	Risk attributes are reviewed and updated by PM, and QA.
4	The GLAST Calorimeter PM and QA will classify and prioritize risks.

4.2.1 Risk Evaluation

Risk evaluation allows the GLAST LAT Calorimeter to better understand the risk by qualifying the expected impact, probability, and timeframe of a risk. This involves establishing values for:

- Impact - Classification based on the severity if the risk should materialize.
- Probability - Classification based on the likelihood of risk occurrence.
- Timeframe - Classification based on the period when mitigation action(s) is needed.

Risks shall be evaluated to determine impact, probability of occurrence, and timeframe. Each risk shall be examined to determine its relationship to all other identified risks.

Table 4-3 demonstrates the values the GLAST LAT Calorimeter will use to evaluate a risk's attributes.

Table 4-3. GLAST LAT Calorimeter Risk Attribute Evaluation

Attribute	Value	Description
IMPACT	CATASTROPHIC	• Cost - ≥ 10% increase to any mission element budget allocation. • Schedule — Slip in delivery of observatory or any major element beyond (4) months of milestone schedule. • Technical — Loss of mission, critical functions or major scientific objective (Level 1). • Safety — Loss of life, permanent disability. • Public Reaction — Bad press for NASA, high publicity issues, withering support by NASA HQ.
	CRITICAL	• Cost - ≥ 5% but < 10% increase to any mission level budget increase. • Schedule - > 2 months ≤ 4 months delay of major elements from milestone schedules. • Technical — Inability to meet power, weight, size and/or performance requirements at mission or element level, or Level 2 (minimum) science objectives. • Safety — Probable serious injury. • Public Reaction — Senior management concerns about mission success or development progress.
	SIGNIFICANT	• Cost - < 5% increase to any mission element budget increase. • Schedule - > 1 month ≤ 2 month delay of deliverable from milestone schedule • Technical —Loss of design margins, loss of level 2 design requirements, loss of redundant systems. • Safety — Risk of injury
	LOW	• Cost — Minor impact • Schedule - ≤ 1 month delay of deliverables • Technical —Small impact to design margins, some desired technical performance not completely met. • Safety - Possible minor injury
PROBABILITY	High (>75% chance of occurrence)	• Occurrence is very likely and may not be controlled by following existing processes, procedures, and plans.
	Significant (25% - 75% chance of occurrence)	• Occurrence is likely and may not be entirely controlled by following existing processes, procedures, and plans.
	Low (5% - 25% chance of occurrence)	• Occurrence is unlikely and may not be entirely controlled by following existing processes, procedures, and plans.
	Negligible (<5% chance of occurrence)	• Occurrence is very unlikely and is generally controlled by following existing processes, procedures, and plans.
TIMEFRAME	IMMEDIATE	• Less than 1 month
	NEAR TERM	• 1-3 months
	MID TERM	• 3-6 months
	FAR TERM	• Greater than 6 months

4.2.2 Risk Classification

The next step is to classify the risk. The purpose of risk classification is to enable the CRMB, and PM to look at a set of risks and how those risks relate to each other within a given structure.

It provides a means to efficiently sort through large amounts of data and build cost-effective mitigation plans. Once risk items are entered and classified in the GLAST LAT Calorimeter Risk Information Sheet, the risk will be assigned an exposure grade (Red/Yellow/Green) by QA based on combinations of the impact/likelihood as shown in Figure 4-1.

		PROBABILITY			
		High	**Significant**	**Low**	**Very Low**
IMPACT	**Catastrophic**	Red	Red	Red	Yellow
	Critical	Red	Red	Yellow	Green
	Significant	Red	Yellow	Green	Green
	Low	Yellow	Green	Green	Green

Figure 4-1. Risk Classification Chart

Items classified as Green are acceptable without further mitigation and shall be routinely tracked for change in status or closed.

Items classified as Yellow may require mitigation. For these items, alternative dispositions will be identified and trade-offs conducted to determine the mitigation required. Future decision milestones will be identified to enable effective tracking of those risks for which immediate action is deemed not necessary.

Items classified as Red are considered primary risk drivers. For these items, mitigation options will be developed. Red risks will be assessed for impact to budget reserves, and will be tracked to closure.

4.2.3 Risk Prioritization

The final step in the risk analysis process is to prioritize identified risks. The purpose of risk prioritization is to provide a means by which the CRMB and PM can sort through a large number of risks and determine which are most important. It allows them to separate out which risks should be dealt with first when allocating mitigation resources. This involves partitioning risks or groups of risks based on the "vital few" and ranking risks or sets of risks based on consistently applying an established set of criteria. The GLAST LAT Calorimeter does not have unlimited resources to mitigate risks. Thus, it is essential to determine consistently and efficiently which risks are most important and then to focus those limited resources on mitigating those risks. The prioritization process is performed as a roll-up function starting at the risk element identified and weighted through the risk process up to the system level. Within the GLAST LAT Calorimeter, identified risk may receive a higher prioritization at the element level than it would when rolled-up to the system level. When required, a multi-voting method will be utilized to prioritize the risks. Someone will be assigned responsibility for each Top 20% risk. Responsibility means that the person assigned the risk must answer for the status and mitigation of the risk.

4.2.4 Reliability Analysis

The GLAST LAT Calorimeter will identify specific reliability concerns and the steps being taken to mitigate them. As a minimum, the GLAST LAT Calorimeter will conduct Failure Modes and Effects Analysis (FMEA) so that mission critical failures are identified and dealt with effectively. Emphasis will be placed on critical single string design features.

4.3 Risk Mitigation Planning

Risk mitigation plans shall be written for any effort that requires an allocation of Project resources. In accordance with NPG 7120.5A, the GLAST LAT Calorimeter shall maintain information such as significant cost and schedule impacts given the occurrence of the risk. The Project will assess potential additional mitigation measures, including a cost comparison, which address the possibility of risk occurrence times the cost of occurrence versus the cost of risk mitigation. Table 4-4 shows the process used by the GLAST LAT Calorimeter for developing risk mitigation plans.

Table 4-4. GLAST LAT Calorimeter Mitigation Planning Process

Step	Action
1	An owner will be assigned responsibility for each Top 20% risks by the GLAST LAT Calorimeter PM or Functional Managers.
2	When requested, each owner is responsible for developing a mitigation plan. The PM and CRMB will decide which action to take on the risk (research, accept, watch, or mitigate).
3	If a mitigation plan is created, the owner shall also develop a contingency plan.
4	All action plans are reviewed and approved by the GLAST LAT Calorimeter PM.

The assigned person, owner, is responsible for developing a risk mitigation plan in sufficient detail to provide the GLAST LAT Calorimeter PM information as to the resources, dependencies, cost, and schedule to mitigate the risk. The GLAST LAT Calorimeter PM shall determine when to use a risk mitigation plan. Additional information is provided in Section 6.2.

In this phase of the GLAST LAT Calorimeter CRM process, the PM or CRMB decides what action, if any, will be taken to manage/mitigate the risk or set of related risks. There are four actions that can be assigned to a risk. The options are:

- RESEARCH the risk to gain more information about it. This may require developing a Research Plan.

- ACCEPT the risk as stated and do nothing about it other than accept it. Document acceptance rationale and close the risk.

- WATCH for identified “triggers” before taking any action about the risk. Define tracking requirements and document.

- MITIGATE the risk to reduce or eliminate it. Create a mitigation plan, assign actions, and monitor activities and risk.

Determination of the number of Top 20% risks to maintain shall be made by the CRMB in conjunction with the PM. The GLAST LAT Calorimeter PM is responsible for reprioritizing risks to determine the Top 20% risks. Only the top five risks shall receive mitigation resources. The remaining risks shall be "watched" or "accepted". Watched risks shall have their attributes examined and reported on a monthly basis. Accepted risks are risks that have been identified but ignored. The Top 20% risks will change throughout the Project life cycle, as new risks appear, other risks are closed, and risk status changes.

5.0 RISK TRACKING, CONTROL, COMMUNICATION, AND DOCUMENTS

Performing risk tracking, control, and communication for the GLAST LAT Calorimeter is necessary to ensure risks are adequately tracked and are not lost in the process. In accordance to NPG 7120.5A, all risks shall be dispositioned before delivery to operations. The following sections describe these phases of the CRM process.

5.1 Risk Tracking

The risk-tracking phase encompasses the acquisition, compilation, and reporting of relevant Project risk information. This phase is necessary to collect accurate, timely, and relevant project risk information and communicate it in a clear and concise manner.

Any risk that is of high priority and needs support beyond the GLAST LAT Calorimeter PI and PM capability will be brought to GLAST LAT PM attention for their resolution.

5.2 Risk Control

During the controlling phase, informed, timely, and effective decisions are made regarding risks and their mitigation plans. Risk control is performed using standard GLAST LAT Calorimeter management monitoring techniques. Controlling risks will be integrated and coordinated in the Project's routine management activities. The following are control plan decisions used by the GLAST LAT Calorimeter PM:

- Replan
- Close the risk
- Invoke a contingency/workaround plan
- Continue tracking and executing the current plan

The decision(s) to proceed with mitigation plans are essential and require current and accurate data to effectively make the proper decision(s). The GLAST LAT Calorimeter PM will have the final decision on risk mitigation planning.

6.0 GLAST LAT Calorimeter CRM Implementation

This section describes the basic methods and tools the GLAST LAT Calorimeter will utilize to

implement an effective CRM program. The goal for implementing CRM on the GLAST LAT Calorimeter is to make maximum use of existing Project management processes and methods. These tools are to be used by individuals, teams and management in identifying, analyzing, planning, tracking, and controlling project risks. The tools and methods specifically used by this project are described in the following sections.

6.1 Mitigation Plans

Risk mitigation plans will be developed for a risk that requires significant resources to reduce or close the risk. GLAST LAT Calorimeter PM will determine when a mitigation plan is required. Information required for a mitigation plan (technical and/or programmatic) includes:

- Title and identification number of the project risk(s) from the GLAST LAT Calorimeter RTL
- Description of how the risk(s) will be mitigated and measurement(s) used to indicate progress.
- Method and frequency of reporting progress and status
- Schedule and resources (hours, dollars, etc.) needed to implement the mitigation plan.
- Individual responsible for the activity and GLAST LAT Calorimeter PM approval to implement the mitigation plan.
- Criteria for a successful implementation.

6.2 Risk Identification Sheet

The GLAST LAT Calorimeter Risk Identification Sheet is the means of identifying and documenting project risks and problems. Information input to the sheet is forwarded to the GLAST LAT Calorimeter PM via e-mail for review and subsequent assessment by the CRMB. Appendix X includes a GLAST LAT Calorimeter Risk Identification Sheet template and process/instructions for entering data.

6.3 Risk Tracking Log

It provides a risk title, description and quick look-up for all identified and accepted project risks. It identifies the person assigned to work/monitor the risk, indicates the completion date for the risk and serves as a tickler file until risks are closed.

APPENDIX A

A-1 Acronyms

CRM - Continuous Risk Management
GSFC - Goddard Space Flight Center
NASA - National Aeronautics and Space Administration
NPG - NASA Procedures and Guidelines
FMEA - Failure Modes Effects Analysis
PM - Project Manager
QA - Quality Assurance
RFA - Response for Action
RIS - Risk Information System
SM – Calorimeter Subsystem Manager
TBQ - Taxonomy Based Questionnaire
TBD - To Be Determined

APPENDIX B

B-1 & B-2 Completing the Risk Information Sheet and Risk Tracking Log

The Risk Information Sheet is described in Figure B-1 and Risk Tracking Log in figure B-2. The form is to be completed no more than seven days after a risk has been identified. Be as accurate and concise as possible when completing the form.

<table>
<tr><td>ID:</td><td colspan="2">Risk Information Sheet</td><td>Date Identified:</td></tr>
<tr><td>Priority</td><td colspan="3" rowspan="3">Risk Statement</td></tr>
<tr><td>Probability</td></tr>
<tr><td>Impact</td></tr>
<tr><td>Timeframe</td><td>Originator</td><td>Classification</td><td>Assigned To</td></tr>
<tr><td colspan="4">Context</td></tr>
<tr><td colspan="4">Approach: Research / Accept / Watch / Mitigate</td></tr>
<tr><td colspan="4">Contingency Plan and Trigger</td></tr>
<tr><td colspan="3">Status</td><td>Status Date</td></tr>
<tr><td colspan="4">Lessons Learned</td></tr>
<tr><td>Approval</td><td>Closing Date</td><td colspan="2">Closing Rationale</td></tr>
</table>

Figure B-1. Risk Information Sheet

SN ID	Impact Probability Timeframe	Risk Title	Assigned	Status

Figure B-2. Risk Tracking Log